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PRODUCTION RESOURCES AND PRACTICES
IN THE WESTERN COTTON REGION

Don E. Ethridge, Dale L. Shaw
and W. C. McArthur

November 1977

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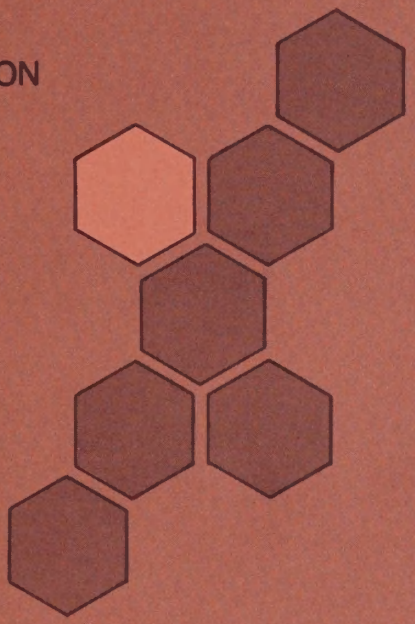

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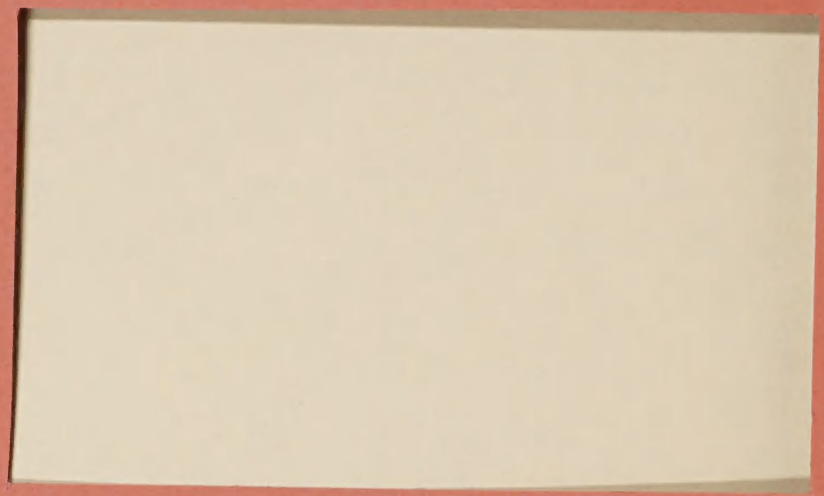

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PRODUCTION RESOURCES AND PRACTICES IN THE WESTERN COTTON REGION

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The Western Cotton region comprises three major production areas: the Mid-Arizona area, the Imperial Valley in Arizona and California, and the San Joaquin Valley in California (figure 1). Cotton is an important crop in all of these areas. It competes with other crops in varying degrees for the use of land, irrigation water, and other resources. Irrigation water is a limiting resource throughout the region.

MID-ARIZONA[2/]

Resources and Land Use

The Mid-Arizona area is made up of Maricopa, Pinal, and Pima counties (figure 2). The area contains approximately 1.0 million acres of cropland; however, not all of it is in production at the same time (table 1). All crops are irrigated. In fact, crop production in Mid-Arizona is not possible without irrigation. It is a field crop region with vegetable, tree, and vine crops being relatively unimportant in comparison with the San Joaquin area in California. Citrus crops are concentrated in Maricopa county (in the Phoenix area), deciduous fruits are located near mountain ranges in Maricopa and Pinal counties, and pecan trees are found in all three counties, also

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[1/] Agricultural Economists, Economic Research Service, U.S. Department of Agriculture. Ethridge and Shaw are stationed at Texas Tech University, Lubbock, Texas; McArthur at the University of Georgia, Athens, Georgia.

[2/] Valuable assistance on this description was received from Scott Hathorn, Jr., Extension Economist, University of Arizona, and Sam Stedman, County Extension Director, Pinal County.

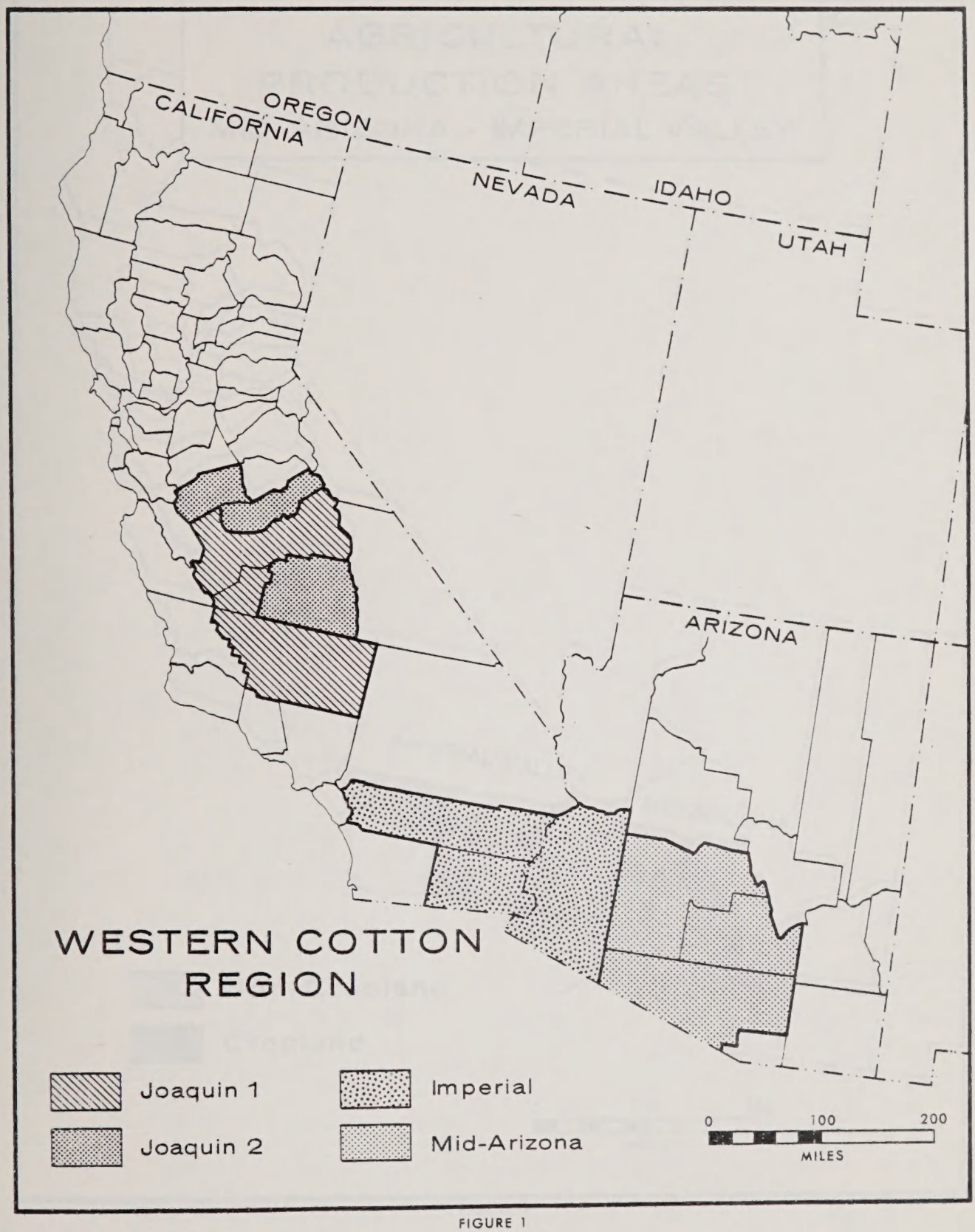
OREGON
CALIFORNIA
NEVADA
IDAHO
UTAH
ARIZONA
WESTERN COTTON REGION
Joaquin 1
Joaquin 2
Imperial
Mid-Arizona
0
100
200
MILES

FIGURE 1

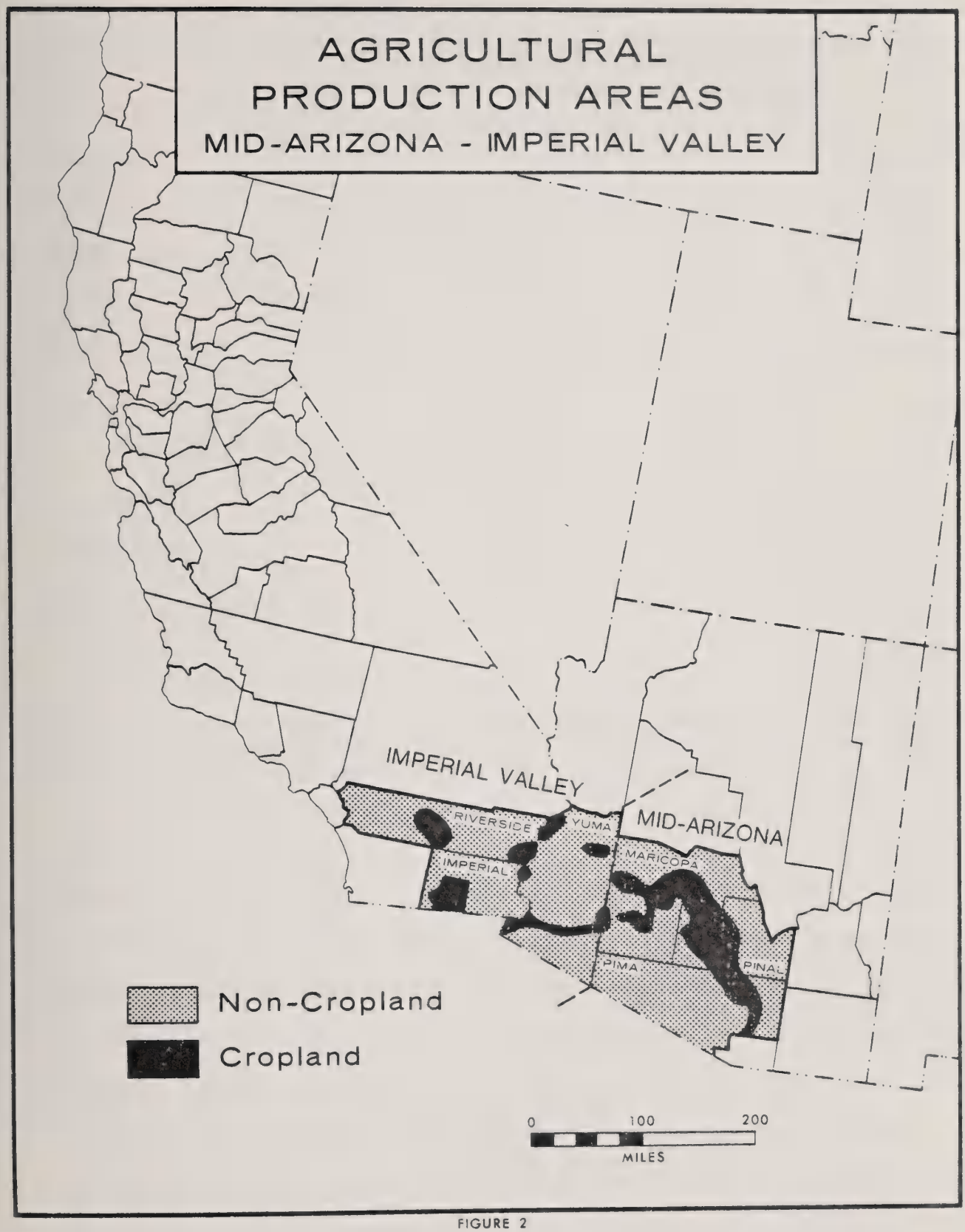
AGRICULTURAL
PRODUCTION AREAS
MID-ARIZONA - IMPERIAL VALLEY
IMPERIAL VALLEY
RIVERSIDE
YUMA
IMPERIAL
MID-ARIZONA
MARICOPA
PIMA
PINAL
Non-Cropland
Cropland
0
100
200
MILES

FIGURE 2

Table 1: Cropland utilization in Mid-Arizona, 1974

Crop	Cropland harvested (1,000 acres)			
	Maricopa county	Pinal county	Pima county	Total
Cotton	165.1	141.2	21.7	328.0
(Pima)	(8.2)	(9.0)	(2.5)	(19.7)
Trees and Vines	28.1	4.7	4.7	37.5
Alfalfa	95.0	17.0	2.2	114.2
Grains	144.7	99.5	22.2	266.4
(Barley)	(43.2)	(33.0)	(5.5)	(81.7)
(Sorghum)	(29.5)	(12.5)	(7.7)	(49.7)
(Wheat)	(71.0)	(54.0)	(9.0)	(134.0)
Vegetables	25.4	4.4	2.5	32.3
Other	16.2	3.0	.6	19.8
Total	474.5	269.8	53.9	798.2

Sources: (1) Arizona Crop and Livestock Reporting Service, Arizona Agricultural Statistics, 1974; and (2) University of Arizona and Statistical Reporting Service, USDA, Cropland Atlas of Arizona, October, 1974.

located near the montains. Vegetable crops consisting mainly of lettuce are scattered over the cropland area. Land in tree and vegetable crops will probably remain in those types of crops for the intermediate run. Maricopa and Pima counties have a problem with urban sprawl around Phoenix and Tucson occupying increasing acreages of irrigated cropland.

The critical difference among the three counties and the difference between the Mid-Arizona region and those further west is in the water situation. The region uses a much higher proportion of groundwater than either the San Joaquin or the Imperial Valley areas. This groundwater is considerably more

expensive which affects cropping patterns. For example, Mid-Arizona has a lower proportion of alfalfa than the Imperial and a higher proportion of cotton. This is undoubtedly influenced by the difference in water costs. Within the region, water costs generally increase from north to south because surface water availability decreases from north to south. All of the agricultural land is located in valleys where both surface and ground water tends to be located (figure 2). There is considerably more non-cropland interspersed with cropland in this area than in the San Joaquin or Imperial areas.

Soils, Topography, Climate

Soils in the area are predominantly silty clays and silty clay loams. The soils in many areas have very low infiltration rates. Infiltration rates are low enough to cause flooding in many of the valley areas from only a few inches of rain. This characteristic combined with the extremely flat topography in the valleys can cause thousands of acres of crop and residential land to stand under water for days following hard rains. However, this phenomenon does not occur often. The land in some areas also has a serious subsidence problem; the land surface settles several feet in some cases over a period of several years. Summer rainfall normally occurs as localized thunderstorms in July and August and may cause crop damage. Winter rains are usually general and steady, and occur in December through March. Annual precipitation is probably split evenly between summer and winter.

Virtually all of the cropland is located in flat valleys which lie between low mountain ranges. As in the Imperial area, the growing season lasts 9 to 10 months. Temperatures vary from mild through most of the winter

to very hot in the summer. Rainfall is normally 8 to 10 inches a year and the elevation ranges from 1,000 to 2,500 feet in the cropped areas.

Water

The water situation within Mid-Arizona varies considerably among areas. Generally, surface water availability declines from north to south; Maricopa county receives about 30 percent of its irrigation water from surface sources, Pinal county about 15 percent. The Pima county supply is totally from ground sources (table 2). Groundwater pumping depths are comparatively deep with well depths generally increasing from south to north. Well depths (pumping lifts) in Pima county range from 250 to 350 feet and average 300-350 feet; the range is 300 to 700 feet (400 to 600 feet average) in Pinal county and 200 to 750 (300 to 550 average) in Maricopa county. For the region as a whole, about 25 percent of the water is from surface sources; the rest from groundwater sources.

Maricopa county obtains surface water mainly from the Salt River Project, irrigating some 210,000 acres of land through 1,300 miles of canals. This water costs farmers $8 to $9 per acre foot at the farm which is composed of about $3.50 per acre foot for water stored at the reservoir plus a delivery charge. Surface water supplies for Pinal county come from the San Carlos Project (Gila River); but it is very limited and unreliable. While this water is available for use on about 100,000 acres (50 percent being allocated to the San Carlos Indian Reservation), only about one acre foot a year per cropland acre is allocated in this county; the water is available only two years out of five on the average. When water is scarce, the irrigated acreage is reduced.

Ground water quality throughout the area is generally poor with some brackish and some hot water, but there is no discernable pattern to the quality. Pumping is from a limestone aquifer and the salinity problem

Table 2: Annual supply of irrigation water available in a typical year, Mid-Arizona

County	Surface water	Groundwater	Total
	----------1,000 acre feet----------		
Maricopa	941	2,049	2,990
Pinal	197	1,115	1,312
Pima	0	412	412
Total	1,138	3,576	4,714

Source: Arizona Water Commission. Arizona State Water Plan, Phase I, July, 1975.

requires that farmers pump about 20 percent additional water in order to leach the salt on some farms. Electricity is the predominant power source. The cost of power has been escalating rapidly. In fact, electricity costs rose about 40 percent in the last half of 1975. The water table in the aquifer has been declining at the rate of four to seven feet per year and some large tracts of land, particularly in Pinal county, have been abandoned because pumping costs became prohibitive on account of power costs or well depths or both. There is no effective groundwater recharge.

Production Practices and Problems

Most farms are full-owner or part-owner operations (appendix tables 1 and 2). Because of the Salt River Project, a Bureau of Reclamation water source, Maricopa county has a high proportion of family corporate farms in order to comply with the 160 acre limitation. Farm sizes are relatively large, particularly in Pinal county. Farms average about 2300 acres overall with about 450 acres of cotton in Pinal county and a smaller acreage in Maricopa and Pima counties. Both cash and share leasing

practices are used with cash rent being slightly more predominant. A common practice is to base the cash lease on the proven yeilds. In Maricopa county, cash leases commonly run $85 to $100 per acre for cotton and $70 to $80 per acre for vegetables (6-month leases on vegetables), depending on the expenses paid by the land owner.

Insect control

Cotton insects include pink bollworm, cotton or tobacco bollworm, and lygus bug. Insecticides such as toxaphene, methyl parathion, and Guthion are used for control. Field inspections are part of their pest management programs; six to eight insecticide applications are considered normal. Aerial application of insecticides is a common practice.

Weed problems

Major weeds are Johnsongrass, bermudagrass, nutsedge, ground cherry, pigweed, and morning-glory. The annual grassy weeds present an early season problem. Farmers tend to use preplant Treflan plus Caparol; layby herbicides are in common use. MSMA and related compounds are used on ditch banks for Johnsongrass control. Disease problems in the area present no major problem except in Maricopa county. The whole area has some early season seedling diseases, but these are of little consequence. Maricopa county has some problems with root rot, nematodes, and verticillium wilt. Control measures consist of wilt-tolerant cotton varieties and crop rotations. Cotton is rotated with small grains, grain sorghum, alfalfa, and occasionally with vegetables on the sandier soils. However, vegetable crops do not tend to fluctuate in total acreage.

Fertilizer use

Fertilizer applications consist mainly of nitrogen. A common fertilizer

program throughout the region consists of 150 to 200 pounds of nitrogen applied in two applications, predominantly in the form of anhydrous ammonia. Preplant nitrogen is occasionally applied in the irrigation water. Some farmers apply small quantities of phosphate (P_2O_5) every third year. Potassium is used hardly at all.

Irrigation Practices

Irrigation systems are predominantly row or border-check from concrete-lined ditches. However, there are signs of increases in sprinkler systems, mostly center pivot. Well yields in the region range from 600 to 3,000 gallons per minute with the lowest well yields generally found in Pinal county and the highest in Maricopa; average well yield in Pinal county is about 800 gallons per minute. The amount of water used on crops tends to be high on account of low rainfall, high evaporation, and poor water quality (table 3). However, with power costs escalating rapidly, farmers are likely to search out and adopt more water-conserving production practices, especially in the higher-cost groundwater areas. Water use priority has tended to be (1) trees and vegetables, (2) cotton, (3) alfalfa, (4) grain sorghum, and (5) wheat and barley. On some water short farms, alfalfa is not watered during peak irrigation requirement periods of other crops.

Machinery Use

Minimum tillage is a common practice. Four-row equipment, with some movement to six and eight-row, is typical for the area. Equipment leasing is minimal but custom operations is a common practice; especially in grain harvesting, hay baling, cotton picking, and deep plowing and ripping. There is some custom land leveling, but only to a limited extent. Nearly all insecticides, herbicides, and defoliants are custom applied by air. Use of

Table 3: Irrigation requirements for major field crops, Mid-Arizona area

Month	Alfalfa stand establishment	Alfalfa hay		Barley	Wheat	Late grain sorghum		Grain sorghum
		Pinal, Maricopa counties	Pima county			Maricopa, Pima counties	Pinal county	
	acre inches							
January								
February		8.0		24.0	30.0			
March		8.0	6.0					
April			6.0					8.0
May		6.0	12.0					
June		6.0	12.0				4.0	
July		12.0	12.0			12.0	10.0	12.0
August		12.0	12.0			12.0	12.0	12.0
September	20.0	4.0	6.0			12.0	12.0	6.0
October		4.0	6.0				6.0	
November		8.0		8.0	8.0			
December								
January								
Total	20.0	68.0	72.0	32.0	38.0	36.0	44.0	38.0

Table 3: (continued)

Month	Upland cotton			Pima cotton		Safflower	Sugar beets	
	Maricopa county	Pinal county	Pima county	Maricopa, Pinal counties	Pima county		Maricopa, Pima counties	Pinal county
	acre inches							
January		12.0	18.0		18.0	6.0		
February								4.0
March	4.0			12.0		6.0	12.0	8.0
April	4.0					12.0	12.0	8.0
May	6.0	6.0		7.0	6.0	12.0	12.0	8.0
June	12.0	12.0	6.0	7.0	12.0	12.0	6.0	4.0
July	18.0	12.0	12.0	14.0	12.0			
August	18.0	12.0	12.0	14.0	12.0			
September		6.0	6.0	7.0			12.0	18.0
October							6.0	6.0
November							12.0	12.0
December						6.0		
January								
Total	62.0	60.0	54.0	61.0	60.0	54.0	72.0	68.0

Source: Hathorn, Scott, Jr., University of Arizona.

module builders is increasing. Typical length of haul from farm to gin is five to 15 miles.

Competing Enterprises

Cotton competes directly with all other field crops (mainly wheat, barley, alfalfa, and grain sorghum) but not with vegetables or tree crops. Cotton is a dominant crop. The acreage planted to cotton reached a peak in the early 1950s, and then dropped to its lowest level in 1967 for the years 1947-74 (appendix table 3). While not a predominant practice, there is some double cropping such as wheat or barley with late cotton, or wheat or barley with late grain sorghum. Mid-Arizona is a winter vegetable area, but labor problems appear to be a barrier to vegetable production. A shift of vegetable acreages to the Indian Reservation might possibly occur because the Reservation is a separate entity which is not subject to U.S. labor laws or EPA regulations on insecticides. Also, the copper mines tend to draw labor out of agriculture. The area grows some sugar beets, but acreage tends to be fixed by processing plant capacity. Several dairies are located in the Phoenix and Tucson areas with feedlots scattered throughout the area; these enterprises foster alfalfa production.

IMPERIAL VALLEY[3/]

Resources and Land Use

The Imperial Valley area is made up of parts of Imperial and Riverside counties, California, and Yuma county, Arizona. The region has over one million acres of harvested cropland, all irrigated (table 4). Crop production is confined to the valley areas where surface water is available for irrigation (figure 2). Agriculture tends to be concentrated around the towns of Indio, El Centro, Blythe, and Brawley in California and along the Colorado and Gila rivers in Yuma county.

In Riverside county, cotton is a relatively minor crop. Tree crops -- dates, citrus, and other orchard crops -- and vegetables are the predominant crops in that county. There are also some grape vineyards. As one moves south into Imperial county, tree and vine crops become scarce and cotton mixed with vegetable crops, sugar beets, alfalfa, and small grains become predominant. Although cotton is an important crop, it is neither the major land tenant nor the primary money crop. Cotton production is scattered throughout the cropland area rather than being concentrated in any particular part of the area. Cotton is commonly grown on the heavier, more saline soils. Further east in Yuma county, vegetables become less predominant and tree crops become much more important than in Imperial county. All of the land area in the Imperial currently in tree crops, vines, and vegetables will probably remain in those or similar crops rather than

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[3/] Valuable assistance on this description was received from Keith S. Mayberry, Farm Advisor, Agricultural Extension Service, Imperial County, California, and Scott Hathorn, Jr., Extension Economist, Cooperative Extension Service, University of Arizona.

Table 4: Cropland utilization in the Imperial valley, 1974

Crop	Cropland harvested (1,000 acres)			
	Imperial county	Riverside county	Yuma county	Total
Cotton	66.0	17.7	58.7	142.4
(Pima)	(N.A.)	(.3)	(4.5)	(4.8)
Trees and vines	3.1	63.2	35.6	101.9
Alfalfa	136.0	43.4	66.0	245.5
Grains	142.2	97.4	71.6	311.2
(Barley)	(10.0)	(42.0)	(4.0)	(56.0)
(Corn)	(.2)	(.1)	(1.0)	(1.3)
(Sorghum)	(24.0)	(5.5)	(10.6)	(40.1)
(Wheat)	(108.0)	(44.0)	(56.0)	(208.0)
Vegetables	84.0	47.9	40.0	171.9
Other	80.5	18.7	10.8	110.0
Total	511.8	288.3	282.7	1082.8

Sources: (1) Arizona Crop and Livestock Reporting Service, Arizona Agricultural Statistics, 1974; (2) California Crop and Livestock Reporting Service, California Field Crop Statistics, 1965-1974; and (3) California Department of Food and Agriculture, Imperial County and Riverside County Agricultural Crop Reports.

shift to cotton or other field crop production. Crop enterprises competing with cotton for land and water are primarily alfalfa, wheat, and possibly grain sorghum or barley. However, the competition is limited since cotton must be rotated with alfalfa and grains to control diseases. There are significant acreages of sugar beets, but these tend to be fixed to some extent by processing capacity.

Topography, Climate, and Soils

Higher elevations are generally not cropped; farming tends to be concentrated in the valleys. Drainage tends to be into the Colorado River between California and Arizona, into the Gila River which cuts across Yuma county, and into the Salton Sea which lies between the cropped areas of Riverside and Imperial counties. The growing season lasts 12 months with a nine to ten month frost-free season; frost seldom occurs before December or after February.

Soils are highly variable, ranging from very fine sands to silty clays. Drainage is a problem on much of the cropland. Tiling to facilitate drainage is a common practice, especially where high value crops such as trees and vegetables are grown. They experience a salt buildup problem in the soils from the high salt content of the irrigation water. Leaching with sprinkler irrigation is a predominant practice in coping with the salt problem. Minimum tillage is not a feasible practice because of the salt buildup.

Water

Approximately 94 percent of the water for irrigation is from surface sources with the remainder from ground water found in small, isolated areas (table 5). Nearly all of the surface water is from either the Colorado

Table 5: Annual supply of irrigation water available in a typical year, Imperial Valley

County	Surface water	Groundwater	Total
	1,000 acre feet		
Imperial	2,381	125	2,506
Riverside	435	23	458
Yuma	808	90	898
Total	3,624	238	3,862

Source: Arizona Water Commission, Arizona State Water Plan, Phase I, July 1975; and Virgil Whitely, Department of Water Resources, Sacramento, California.

or Gila rivers. Much of the water has a high salt content. Water costs in the Imperial Valley are substantially lower than in the San Joaquin, which probably explains at least part of the relative predominance of alfalfa in the Imperial.

The limited quantity of surface water and the high cost and poor quality of groundwater is the major constraint on land in cultivation. The difference between land under cultivation and the land not cultivated is determined by the availability of water. There is little, if any, prospect for additional surface water. With energy costs rising rapidly, new land development does not appear feasible. In fact, increasing pumping costs could force abandonment of existing irrigation wells, particularly in Yuma county.

Production Practices and Problems

Most cotton farms in the Imperial Valley are owner-operated with some land being leased (appendix tables 4 and 5). Farms in this area tend to be smaller than farms in the San Joaquin, especially the west side of the San Joaquin. Corporate farms are not common to the area. Both cash and share-rent leasing are practiced, but cash leasing is more prevalent. Cotton varieties used in the area are a mixture of Deltapine, Stoneville, and Acala; there is also a small amount of Pima cotton. Good land that is already in production sells for about $1,000 to $1,500 per acre. Land typically leases for $100 to $150 per acre for cotton, sugar beets, and small grains.

Insect and Disease Control

Insects present a major problem in cotton production. The major insect problem is the pink bollworm, but the lygus bug and tobacco budworm are also becoming a problem to cotton growers. Although crop rotations are used to minimize the problem, farmers still use about 10 insecticide applications per year to control the bollworm. The primary disease problem is bollrot; crop rotation is the main line of defense. Common rotation patterns are 3 years cotton-3 years alfalfa, and cotton-wheat-grain sorghum-fallow (2 years).

Weed Problems

Weed problems include perennials and annuals -- ground cherry, Canary grass, nutsedge, pigweed, goosefoot, white horse nettle and a variety of other plants; Johnsongrass is not a problem. Most farmers use a chemical weed control program in cotton consisting of Treflan, Caparol, and Dacthal; Dacthal preplant and Treflan at layby is the predominant pattern. Hand-hoeing is not a common practice.

Irrigation Practices

Irrigation systems are primarily row or border-check systems. Hand-move sprinkler systems, generally leased from equipment companies, are commonly used to irrigate sugar beets and vegetable crops immediately after planting but usually not for post-emergence irrigation. These irrigation practices are undoubtedly influenced by the relative abundance or low cost of irrigation water and the existing salinity problem. Water application rates are relatively high with more than 3.5 acre feet being applied to cotton (table 6).[4/] Cotton yields average about 2.5 bales per acre (appendix table 6).

Fertilizer Use

Fertilizer applications consist almost entirely of nitrogen applied in split applications as anhydrous ammonia. Rates are high, particularly in Imperial and Riverside counties, ranging around 200 to 240 pounds and sometimes 300 pounds of N per acre on cotton. Fertilizer practices in Yuma county involve lower rates of nitrogen and higher rates of phosphorous. Also, more dry fertilizer is applied.

Machinery Use

Most farm equipment is four and six row; there is no apparent trend toward 4 wheel-drive tractors. Custom operations are predominant for planting and harvesting of most crops. Fertilizers and insecticides are mostly custom applied. Seedbed preparation is commonly done by the owner-operator.

4/ While the data in table 6 relate specifically to Yuma county, Arizona, irrigation requirements are similar for these crops in Imperial and Riverside counties, California.

Table 6: Irrigation requirements for major field crops, Yuma county

Month	Alfalfa stand establishment	Alfalfa hay	Cotton	Barley	Wheat (double crop)	Milo (double crop)	Safflower
	acre inches						
January		4.0	5.0		4.5		6.0
February		4.0	5.0	17.0	8.0		
March		4.0		8.0	8.0		7.0
April		8.0		8.0	8.0		7.0
May		8.0	6.0				12.0
June		8.0	12.0			12.0	4.0
July		8.0	12.0			6.0	
August		8.0	6.0			6.0	
September	6.0	4.0				12.0	
October	8.0	4.0					
November	4.0	4.0					
December		4.0			4.5		6.0
Total	18.0	68.0	46.0	33.0	33.0	36.0	42.0

Source: Hathorn, Scott, Jr., University of Arizona.

SAN JOAQUIN VALLEY[5/]

Resources and Land Use

The San Joaquin Valley contains about 3.75 million acres of harvested cropland, almost all irrigated (table 7). Of the harvested cropland in 1974, about 30 percent was allocated to cotton, 20 percent to tree and vine crops, 20 percent to grain crops, 12 percent to alfalfa, and 5 percent to vegetables. Further expansion of the cropland base is entirely dependent on the availability of irrigation water. Any expansion would have to occur mostly on the west side of the valley because the land is almost fully developed to the base of the mountains on the east side. The new land area on the west side of the valley has been brought into production by the importation of water through the California Aqueduct Bureau of Reclamation projects, and prospects for additional surface water there are very low for at least the intermediate term. Therefore, new land development, which is unlikely to occur in significant acreages, must be associated with additional irrigation wells on the west side where wells are generally deep and the water is relatively expensive.

The San Joaquin can be divided into three distinct areas on the basis of soils, water, production practices and problems, and crops grown. These districts are the east side, center and west side (figure 3). The east side is devoted primarily to tree crops and vines with some vegetables, clover pasture, and dryland grain. These are relatively high-

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[5/] Valuable assistance on this description was received from William R. Clark, Assistant Agriculture Commissioner, Tulare County; George V. Ferry, County Extension Director, Kings County; and Clarence Johnson, Farm Advisor, Madera County.

Table 7: Cropland utilization in the San Joaquin Valley, 1974

Crop	Cropland harvested (1,000 acres)						
	Kern county	Kings county	Fresno county	Tulare county	Madera county	Merced county	Total
Cotton	318.2	198.4	373.8	164.0	50.5	49.3	1,154.2
Trees and vines	99.1	13.0	246.3	210.2	60.8	72.4	701.8
Alfalfa	115.0	51.0	90.0	101.0	50.7	62.7	470.4
Grains	129.6	153.5	252.6	140.2	57.3	86.7	819.9
(Barley)	(50.0)	(95.0)	(170.0)	(42.0)	(25.0)	(25.0)	(407.0)
(Corn)	(8.3)	(15.0)	(18.0)	(36.0)	(22.0)	(21.0)	(120.3)
(Sorghum)	(14.5)	(7.0)	(12.0)	(22.0)	(3.0)	(7.0)	(65.5)
(Wheat)	(50.0)	(36.0)	(35.0)	(37.0)	(6.5)	(15.0)	(179.5)
Vegetables	80.6	5.8	81.8	6.3	.6	22.6	197.7
Other	57.9	66.0	112.5	75.7	17.6	75.3	405.0
Total	800.4	487.7	1,157.0	697.4	237.5	369.0	3,749.0

Sources: (1) California Crop and Livestock Reporting Service, California Field Crops Statistics, 1965-74; (2) California Department of Food and Agriculture, Agricultural Crop Reports, 1974: Kern County, Fresno County, Kings County, Madera County, Merced County, and Tulare County.

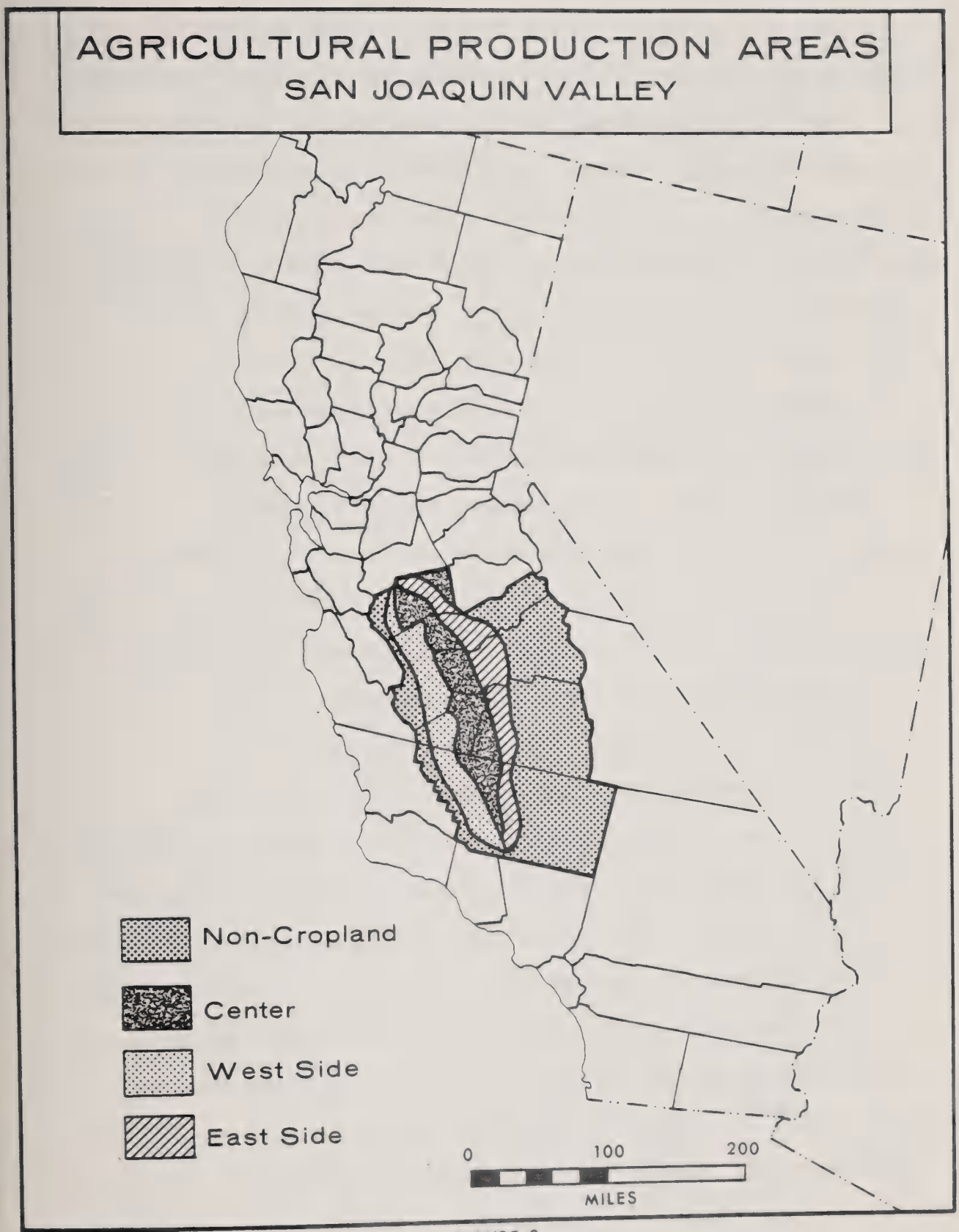
AGRICULTURAL PRODUCTION AREAS
SAN JOAQUIN VALLEY
Non-Cropland
Center
West Side
East Side
0
100
200
MILES

FIGURE 3

value, high-investment, labor-intensive crops. Land in these crops can be expected to remain in that use or at least in the production of similar types of crops for the intermediate term. The field crops (mainly cotton, alfalfa, sugar beets and grains) compete for the remaining land and water. For purposes of breaking the San Joaquin into two study areas on the basis of counties, most of the differences in county data on yields, farm size, and so forth can be explained on the basis of the proportion of each county identifiable with east side, center, and west side. All counties in San Joaquin 1 (Kern, Kings, and Fresno counties) have land area on the west side of the valley, but Kings county has no land on the east side. The counties in San Joaquin 2 (Tulare, Madera, and Merced counties) have little or no land on the west side; the exception being Merced county which has a small amount of land on the west side.

The west side is devoted mostly to cotton and other field crop production. There are some vegetables on the west side, particularly tomatoes and melons, but only a small proportion. The center area is more of a mixture of cropping patterns of the east and west. Cotton and grain crops are found in the center, but are not nearly as predominant as on the west side. Grapes are concentrated more in the center. The central area grows considerable acreages of vegetables and alfalfa. There has been a large increase in the number of dairies which have been forced out of the Los Angeles area by urban sprawl; these have tended to concentrate more toward the center of the valley. This is causing some replacement of cotton and grain crops with silage corn, alfalfa hay, and similar activities associated with dairying. There has been a steady increase over time in the proportion of vegetable crops throughout the valley.

Topography, Climate, and Soils

Higher elevations are found along the eastern side of the valley. The terrain slopes from the mountains on the east to the center of the valley, rises slightly on the west side, and joins the mountains on the west side rather abruptly. Normal drainage is from east and west and to the center and then north through the valley, flowing eventually to the San Francisco Bay. The growing season is the longest on the west side, being as much as two weeks longer than the higher elevations on the east side. However, the valley has no problem with the length of the growing season for annual crops; they normally have nine to ten months of frost-free weather (from early February or March through November). While the east side tends to have earlier frost dates, the mountains tend to protect the east side from hard freezes; this is a contributing factor to the predominance of tree crops, especially citrus, on the east side.

Soils on the east side are more fertile, granitic in origin, highly compactable, and have lower infiltration rates and hardpan layers with some rocky soils. Deep tillage is a common practice in dealing with the compaction problem. West-side soils are sedimentary alluvial in origin, quite homogeneous, generally clay loams, highly compactable (but not as compactable as east side soils) and tend to have subsidence problems (when irrigated, the soil settles in an irregular pattern). Soils in the center area are more heterogeneous, mixed alluvial in origin, spotted with old lake beds, and predominantly loams and saline sodic clays and clay loams. Of the total cropland base in the San Joaquin, roughly 25 percent is on the west side, 40 percent in the center area, and 35 percent on the east side.

Irrigation Water

Water for irrigation in the San Joaquin comes from both surface and ground sources. While total irrigation water is almost evenly split between ground and surface sources, some groundwater is pumped into the surface distribution systems (table 8). Surface water also is a source of recharge for the groundwater. Major surface water sources are shown in figure 4. Federal Bureau of Reclamation water is generally lower in cost to users than water through the California Water Plan. Both are generally lower in cost than west-side groundwater. Federal and State waters are frequently mixed in the same distribution system. For example, Federal and State waters jointly use the California Aqueduct. Surface water costs tend to increase as one proceeds south through the valley because of greater transportation costs and the fact that it is necessary to pump to higher elevations. Groundwater costs generally tend to increase from east to west because of greater pumping depths. Well depths range from as little as 20 feet on the east side to as much as 1,000 feet on the west side.

Both the east and west sides rely primarily on canal water supplemented with pumped water. The center area relies primarily on ground water but it has supplementary surface water. The east-side surface water is primarily mountain snow-pack runoff which is stored in reservoirs and released as the irrigation districts dictate. West-side surface water is primarily from the California Aqueduct. There is generally no problem with the time-distribution of surface water since the surface water is released as required. However, water availability in the low use periods (primarily December-February) may exceed storage capacity;

Table 8: Annual supply of irrigation water available in a typical year, San Joaquin Valley

County	Surface water	Groundwater	Total
	----------1,000 acre feet----------		
Kern	1,850	1,400	3,250
Kings	1,350	1,100	2,450
Fresno	1,800	1,950	3,750
Tulare	1,200	950	2,150
Madera	400	400	800
Merced	600	1,200	1,800
Total	7,200	7,000	14,200

Source: Whitely, Virgil. Department of Water Resources. Sacramento, California.

a situation giving rise to what is known as Class 2 water which is sold at the cost of transportation, usually about $2 per acre foot. Class 2 water plays a more important role on the east side because more is available there. However, this water does not exist every year. It depends on the amount of winter snow in the eastern mountains.

Given normal surface water sources, the groundwater situation, and the present acreage in cultivation, water will not likely be a constraining resource in the San Joaquin in the near term. Surface water supplies should be rather stable barring severe fluctuations in winter snow pack in the mountains, severe drought, and/or rapid urbanization to take water on a priority basis. Groundwater supplies are adequate for the present number of wells unless surface recharge diminishes.

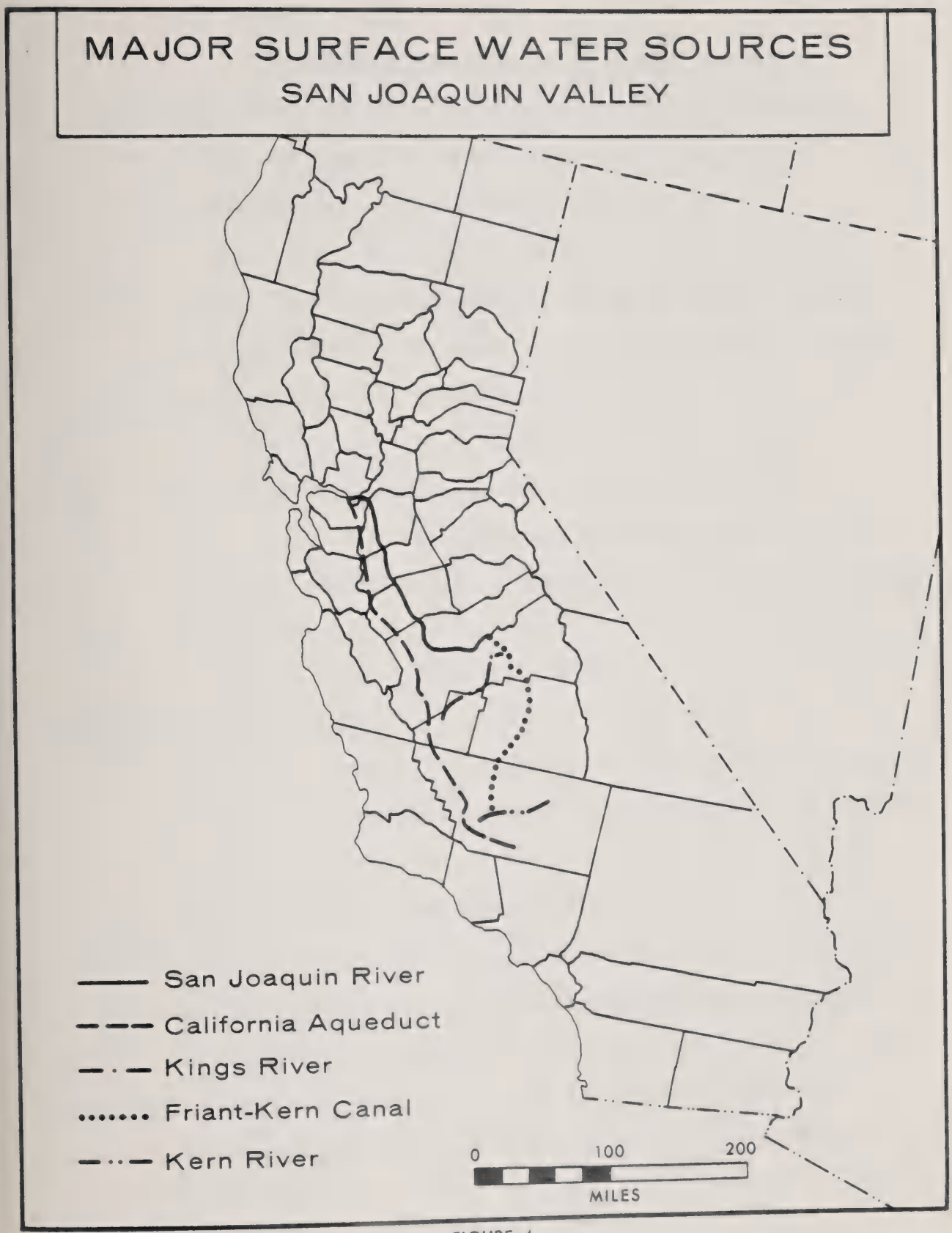
MAJOR SURFACE WATER SOURCES
SAN JOAQUIN VALLEY
San Joaquin River
California Aqueduct
Kings River
Friant-Kern Canal
Kern River
0
100
200
MILES

FIGURE 4

Production Practices and Problems

Most farms in the San Joaquin are owner-operated or owner-operated with some leased land (appendix tables 7-10). Corporate farms having in excess of 10,000 acres are not uncommon. The larger field crop farms tend to be located mostly on the west side and in the lake basins. This is fostered by the relative homogeneity of the soils, making management on the large units simpler. The existence of family corporate farms and leasing is encouraged by the 160 acre per person limitation to qualify for Bureau of Reclamation water. Share crop leasing is the predominant leasing practice, but cash leasing is not uncommon. All of the cotton grown in the valley is of the Acala variety by legislative fiat and two strains predominate; the difference in the two strains is their tolerance to verticillium wilt.

Insect and Disease Control

The major insect pests in cotton and other crops are lygus bugs and spider mites; however, there is a growing concern throughout the valley over the pink bollworm threat to cotton. Insect control programs seem to rely on field inspections and recommendation of consulting entomologists more than on set patterns of insecticide applications. Generally, no more than three insecticide applications are used (two for lygus and possibly one for mites). The only widespread pink bollworm control practice in effect at the present time is a requirement that all cotton land be plowed under by a specified date to prevent any overwintering.

The most predominant disease problem is verticillium wilt, which affects olive trees, pistachio, plums, peaches, almonds, cauliflower, and citrus as well as cotton. Wilt occurs with the first cool weather; if wilt occurs after the crop is made yields are not affected; otherwise, production suffers. Wilt is present throughout the valley. However, it is more of a problem on the east side because cool weather generally occurs earlier in that area and also the land, particularly the land in cotton, has been in cultivation for a longer period. The primary means of control is crop rotation; for example, cotton rotated with grains or alfalfa. Two of the most widely used rotation patterns are 3 years in cotton and 3 years in alfalfa; and a 2-year, double crop rotation of cotton, barley or wheat, or corn, or grain sorghum and winter fallow.

Weed Problems

The worst weed problems are the perennials -- Johnsongrass, nutsedge, Bermudagrass, field bindweed. Annuals such as nightshade, ground cherry, and water grass also cause problems. The most common weed control program consists of preplant Treflan for the annual weeds with 1 or 2 hand hoeings and 3 to 5 mechanical cultivations. The high incidence of hand weed control and low use of post-emergence herbicides is fostered by the availability of relatively low cost labor and the aversion to using post-emergence herbicides with existing crop rotation patterns. Loss of the low-cost labor could alter weed control as well as other production practices. Weeder geese are being used in some areas.

Irrigation Practices

Irrigation practices are a mixture of row or border check systems and sprinkler systems. The east side and center areas irrigate mostly

with row or border check systems. Tree and vine crops generally are irrigated with row or border check systems or with permanent underground pipe systems. Sprinklers served by permanent underground pipe or pull-hose distribution systems are sometimes used where water quantity is limited and cost is high. Hand-moved sprinkler systems are more commonly used on field crops on the west side because of the higher infiltration rates and the greater subsidence problem in the area. Hand-move systems have been retained because of the higher capital investment of the automatic move systems and the relative availability of labor; some automatic-move systems require infiltration rates higher than possible for their soils. Since sprinkler irrigation is 20 to 40 percent more efficient in water use than surface irrigation (table 9) and if labor becomes relatively more expensive, increased use of automatic move sprinkler irrigation is likely to occur, particularly on the west side. Because of infiltration rate barriers, side-roll types of automatic-move sprinklers will probably become more popular than circle-move types. Overhead sprinkler systems foster a problem with angular leaf spot in cotton; consequently, they are used less on cotton than on other field crops.

Fertilizer Use

Fertilizer practices involve primarily nitrogen applied as anhydrous ammonia (NH_3) in split applications. Moderate application rates, about 75 to 100 pounds per acre on cotton are applied in two equal applications on the courser soils of the center and east side areas. Heavier rates, ranging from around 125 to 175 pounds per acre on cotton, are used on the finer textured west side soils with a lower preplant application and heavier sidedressing application during cultivation. Some zinc, phosphate

Table 9: Irrigation requirements for selected crops in the San Joaquin area

Month	Acre inches per month for specified crops					
	Double crop barley and grain sorghum	Cotton	Sugar beets	Citrus	Deciduous orchards	Grapes
	Surface irrigation					
January					10.0	
February		15.0		6.0		
March	6.0		5.0			
April	6.0		9.0	6.0	6.0	
May			5.0	6.0	9.0	7.5
June	10.0	5.0	9.0	9.0	12.0	
July	7.0	12.0	7.5	9.0	9.0	12.0
August	12.0	12.0	4.5	12.0	6.0	7.5
September	9.0			10.0		
October				8.0		
November			6.0			
December	10.0					15.0
Total	60.0	44.0	46.0	66.0	61.0	42.0
	Sprinkler irrigation					
January					7.5	
February		12.0		4.0		
March	4.0		3.0			
April	4.0		5.0	4.0	4.5	
May			3.0	4.0	6.0	4.5
June	7.5	4.5	5.0	6.0	6.0	
July	5.0	9.0	5.0	6.0	9.0	9.0
August	8.0	9.0	3.0	9.0	6.0	4.5
September	7.5			7.0	4.5	
October				5.0		
November			4.0			
December	7.5					15.0
Total	43.5	34.5	28.0	45.0	43.5	33.0

Source: Booher, L.J. and George V. Ferry, "Estimated Consumptive Use and Irrigation Requirements of Various Crops."

(P_2O_5), and potash (K_2O) are used, but only on a scattered basis and in light applications.

Machinery Use

Most farmers own most of their equipment, but equipment leasing and custom work, especially the latter, are becoming increasingly popular, especially for those operations for which the equipment requires a large investment. The smaller farms rely more heavily on custom work than do the larger ones. Custom harvesting of cotton, grains, and alfalfa is the general practice; nearly all applications of insecticides and defoliants on field crops are done on a custom basis. Custom application of herbicides also is a rapidly increasing practice. Some contracting occurs for deep tillage and seedbed preparation. Six and eight-row equipment predominates in field crops on the west side and the proportion of 4-wheel-drive tractors is increasing, mostly replacing 2-wheel-drive tractors, but also replacing some track vehicles. Field crop equipment on the east side is predominantly four row. Cotton ricks and modules are both being used and modules are rapidly being adopted for seed cotton handling.

Acreage and Yield Trends

The acreage planted to cotton increased sharply after 1974, and, except for a couple of years in the mid-1960s, it has remained at a relatively high level since that time (appendix tables 11-12). Lint yield per acre also increased substantially from the 1947 level.

REGIONAL SUMMARY

The Western region, comprising three distinct production areas (Mid-Arizona, the Imperial Valley, and the San Joaquin Valley), is a major cotton region. Relatively high yields and good quality lint characterize Far West cotton. Other characteristics of the region include a long growing season, generally flat terrain, low rainfall, and relatively fertile soils. Irrigation water is essential to the production of cotton and other crops in all parts of the region. Although available from both surface and groundwater sources, water for irrigation is a limiting resource throughout the region. Groundwater provides a much larger proportion of the irrigation water in Mid-Arizona than in either the Imperial Valley or the San Joaquin Valley. This water is generally much more expensive for irrigation than surface water; a factor that impacts on cropping patterns.

Insect and weed control is a major component of production costs in the Far West areas as in most other parts of the Cotton Belt. The pink bollworm threat to cotton is a growing concern to growers in some areas. Fertilizer use includes relatively high rates of nitrogen, generally applied in the form of anhydrous ammonia. Inputs of phosphate and potash are minor in most areas.

Irrigation practices in an area generally include some combination of row or border check and sprinkler systems. Labor limitations, cropping system, water supply, and relative costs, among other things, influence the irrigation system used on individual farms.

Large producing units also characterize the region. The relatively large fields favor the use of large tractors and equipment. Four and six-row equipment are typical units in most areas. The use of six and eight-row equipment predominates in parts of the San Joaquin Valley.

Cotton is a strong competitor in the Western region, particularly in Joaquin 1. It appears to be less competitive in parts of the Imperial Valley where vegetable and fruit production may have an advantage. Shifts in the competitive strength of cotton among areas in the Far West may hinge in large measure on the availability and cost of irrigation water in the years ahead. These factors tend to work to the disadvantage of the heavier water users such as alfalfa.

Appendix Table 1. Selected characteristics of farms with sales of at least $2,500, Mid-Arizona, 1974

Item	Farms reporting	Average per farm	Average per farm reporting	Acreage irrigated	Acreage fertilized	Yield per acre
	Percent	Acre	Acre	Percent	Percent	
Total number farms - 2,058: Total acres - 4.4 million						
Total land (acres)	100	2,150	2,150	16	13	
Cropland	78	426	545	79		
Cotton	37	147	395	100	99	2.4 bls.
Wheat	22	52	240	100	94	65 bu.
Barley	13	18	135	100	91	71 bu.
Sorghum	11	15	142	100	81	1/67 bu.
Hay	31	46	152	100	34	5.6 tons
Vegetables	6	14	220	100	100	
Orchards	13	20	156	100	61	
Irrigated land	75	337	452	100		
Furrows or ditches	52	256	489			
Sprinkler systems	4	4	106			
Irrigated cropland	74	335	455	100		
Land fertilized	64	289	452		100	
Row crop insecticides	35	181	517			
Crop herbicides	22	123	557			
Defoliants	17	85	484			
Ownership:						
Full owners	53	293	550			
Part owners	26	1,477	5,627			
Tenants	20	380	1,858			
Size:						
100-499 acres	24					
500-1,999 acres	21					
2,000 acres and over	11					
Operator age 65 and over	14					
Operators working off-farm:						
200 days and over	21					
		Number				
Wheel tractors	78	3.2	4.0			
1970 or newer		1.0	1.3			
Crawler tractors	24	0.4	1.8			
Acre ft. irrigation water applied per acre			4.3			

1/ Harvested for grain

Source: Bureau of the Census, U.S. Dept. of Commerce, 1974 Census of Agriculture

Appendix Table 2. Selected characteristics of farms with sales of at least $2,500, Mid-Arizona, 1969

Item	Farms reporting	Average per farm	Average per farm reporting	Acreage irrigated	Acreage fertilized	Yield per acre
	Percent	Acre	Acre	Percent	Percent	
Total number farms - 2,043:						
Total acres - 4.7 million :						
Total land (acres) .....:	100	2,290	2,290	16	17	
Cropland .....:	78	476	611	75		
Cotton .....:	40	112	285	100	100	2.0 bls.
Wheat .....:	13	15	117	100	91	60 bu.
Barley .....:	27	54	203	100	93	70 bu.
Sorghum .....:	22	39	178	100	92	1/60 bu.
Hay .....:	31	54	172	99	30	5.2 tons
Vegetables .....:	8	23	282	99	99	
Orchards .....:	16	14	90	100	80	
:						
Irrigated land .....:	74	361	485	100		
Furrows or ditches .....:						
Sprinkler systems .....:						
Irrigated cropland .....:	74	359	486	100		
:						
Land fertilized .....:	64	397	622		100	
Row crop insecticides ....:	45	167	370			
Crop herbicides .....:	27	109	406			
Defoliants .....:	26	84	323			
Ownership: :						
Full owners .....:	48	179	369			
Part owners .....:	32	1,757	5,440			
Tenants .....:	19	354	1,838			
Size: :						
100-499 acres .....:	25					
500-1,999 acres .....:	24					
2,000 acres and over ...:	12					
:						
Operator age 65 and over :	11					
Operators working off-farm:						
200 days and over .....:	23					
:		Number				
Wheel tractors .....:	74	2.7	3.7			
1965 or newer .....:		0.9	1.3			
Crawler tractors .....:	30	0.5	1.5			
Acre ft. irrigation :						
water applied per acre :			N.A.			
:						

1/ Harvested for grain

Source: Bureau of the Census, U.S. Dept. of Commerce, 1974 Census of Agriculture

Appendix table 3. Cotton acreage, yield, and production, Mid-Arizona area, 1947-74

Year	Acres planted	Acres harvested	Bales produced	Pounds of lint yield per acre
1947	203,715	202,765	209,643	496
1948	247,900	246,950	293,140	569
1949	339,000	338,200	490,500	696
1950	248,700	244,000	435,462	856
1951	500,700	493,700	705,330	685
1952	574,500	570,300	812,570	683
1953	543,900	540,700	896,035	795
1954	353,695	344,995	768,615	1,069
1955	306,730	294,875	634,224	1,032
1956	310,700	298,960	716,420	1,150
1957	299,050	286,930	651,555	1,089
1958	317,880	311,450	603,845	930
1959	315,280	310,700	490,490	912
1960	357,600	351,200	707,700	967
1961	330,500	324,800	693,800	1,025
1962	336,100	331,000	778,900	1,129
1963	320,300	313,700	676,100	1,034
1964	309,400	304,900	632,800	996
1965	425,700	420,100	951,700	1,087
1966	203,500	202,700	402,363	952
1967	196,700	196,000	368,317	902
1968	234,100	233,700	583,930	1,199
1969	241,500	240,950	484,509	965
1970	211,300	210,150	396,273	882
1971	215,510	214,780	395,240	883
1972	228,050	227,650	501,180	1,056
1973	218,400	218,400	503,270	1,106
1974	307,550	307,550	788,350	1,230

Sources: Statistical Reporting Service, USDA.

Appendix Table 4. Selected characteristics of farms with sales of at least $2,500, Imperial Valley, 1974

Item	Farms reporting	Average per farm	Average per farm reporting	Acreage irrigated	Acreage fertilized	Yield per acre
	Percent	Acre	Acre	Percent	Percent	
Total number farms - 3,048						
Total acres - 1.3 million						
Total land (acres)	100	431	431	67	64	
Cropland	84	332	393	86		
Cotton	15	48	334	100		2.3 bls.
Wheat	20	59	297	91	93	66 bu.
Barley	3	14	420	36	47	39 bu.
Sorghum	5	12	218	81	72	1/59 bu.
Hay	26	80	311	97	73	6.4 tons
Vegetables	9	39	431	97	99	
Orchards	40	30	74	97	86	
Irrigated land	79	287	362	100		
Furrows or ditches	38	145	382			
Sprinkler systems	17	29	166			
Irrigated cropland	77	284	367	100		
Land fertilized	68	278	409		100	
Row crop insecticides	36	156	433			
Crop herbicides	24	140	594			
Defoliants	9	31	354			
Ownership:						
Full owners	64	98	153			
Part owners	20	214	1,085			
Tenants	16	118	739			
Size:						
100-499 acres	23					
500-1,999 acres	13					
2,000 acres and over	5					
Operator age 65 and over	17					
Operators working off-farm:						
200 days and over	26					
		Number				
Wheel tractors	72	2.4	3.3			
1970 or newer		.8	1.1			
Crawler tractors	20	.4	1.9			
Acre ft. irrigation water applied per acre			4.6			

1/ Harvested for grain

Source: Bureau of the Census, U.S. Dept. of Commerce, 1974 Census of Agriculture

Appendix Table 12. Cotton acreage, yield, and production, San Joaquin 2, 1947-74

Year	Acres planted	Acres harvested	Bales produced	Pounds of lint yield per acre
1947	173,050	171,950	213,784	596
1948	259,200	257,920	289,600	538
1949	303,700	301,100	367,420	585
1950	181,100	178,700	260,999	701
1951	422,150	418,100	486,430	558
1952	416,300	413,300	476,130	552
1953	373,000	371,100	413,240	534
1954	256,760	254,700	363,750	685
1955	221,450	216,930	278,000	615
1956	225,300	219,720	355,500	776
1957	206,150	202,500	368,600	873
1958	214,640	209,800	394,000	901
1959	257,800	251,000	493,400	943
1960	274,500	268,800	484,200	864
1961	242,600	237,000	440,920	893
1962	239,500	234,170	457,300	937
1963	215,950	211,000	373,480	849
1964	216,330	212,770	395,480	892
1965	210,290	206,040	353,610	823
1966	168,470	164,800	252,540	735
1967	159,090	157,430	236,885	722
1968	196,500	195,180	348,405	856
1969	198,400	197,150	289,090	703
1970	179,150	178,300	262,420	706
1971	181,540	176,900	231,100	627
1972	205,000	202,600	342,850	812
1973	213,710	213,710	305,600	686
1974	263,800	263,800	443,000	806

Sources: Statistical Reporting Service, USDA.

Appendix Table 5. Selected characteristics of farms with sales of at least $2,500, Imperial Valley, 1969

Item	Farms reporting	Average per farm	Average per farm reporting	Acreage irrigated	Acreage fertilized	Yield per acre
	Percent	Acre	Acre	Percent	Percent	
Total number farms - 3,210						
Total acres - 1.5 million						
Total land (acres)	100	460	460	57	63	
Cropland	86	310	362	83		
Cotton	17	30	178	100	100	2.2 bls.
Wheat	9	16	180	90	88	63 bu.
Barley	14	39	275	72	74	59 bu.
Sorghum	8	19	234	100	95	1/60 bu.
Hay	26	70	274	95	61	5.7 tons
Vegetables	9	44	385	100	93	
Orchards	42	26	61	98	98	
Irrigated land	78	260	332	100		
Furrows or ditches						
Sprinkler systems						
Irrigated cropland	77	256	331	100		
Land fertilized	71	289	404		100	
Row crop insecticides	44	119	270			
Crop herbicides	26	82	314			
Defoliants	11	22	197			
Ownership:						
Full owners	64	93	144			
Part owners	21	286	1,384			
Tenants	15	81	544			
Size:						
100-499 acres	23					
500-1,999 acres	13					
2,000 acres and over	4					
Operator age 65 and over	15					
Operators working off-farm						
200 days and over	33					
		Number				
Wheel tractor	65	2.0	3.1			
1965 or newer		0.7	1.1			
Crawler tractor	26	0.5	2.1			
Acre ft. irrigation water applies per acre			N.A.			

1/ Harvested for grain

Source: Bureau of the Census, U.S. Dept. of Commerce, 1974 Census of Agriculture

Appendix Table 6. Cotton acreage, production, and yield, Imperial Valley, 1947-74

Year	Acres planted	Acres harvested	Bales produced	Pounds of lint yield per acre
1947	4,300	4,300	3,535	394
1948	6,940	6,940	6,250	432
1949	14,520	141,150	16,001	542
1950	7,624	7,514	10,552	674
1951	94,385	93,250	131,660	677
1952	179,520	177,900	262,765	708
1953	238,430	237,600	346,270	699
1954	127,890	125,185	249,380	956
1955	95,520	92,185	175,204	912
1956	98,745	95,030	194,750	983
1957	96,010	93,100	196,525	1,013
1958	101,280	97,810	235,880	1,157
1959	112,240	109,530	242,100	1,060
1960	121,280	118,550	294,950	1,194
1961	106,960	103,700	268,300	1,241
1962	109,680	106,850	341,500	1,534
1963	99,800	96,640	321,860	1,598
1964	99,750	97,500	335,340	1,650
1965	97,955	95,580	325,730	1,635
1966	75,800	72,865	193,720	1,276
1967	74,260	73,340	142,040	929
1968	87,950	85,515	276,270	1,550
1969	100,470	99,330	219,385	1,060
1970	80,200	78,860	140,950	857
1971	74,100	72,500	131,530	870
1972	80,650	79,950	194,260	1,166
1973	88,200	88,200	204,000	1,110
1974	138,000	138,000	425,400	1,479

Sources: Statistical Reporting Service, USDA.

Appendix Table 7. Selected characteristics of farms with sales of at least $2,500, San Joaquin 1, 1974

Item	Farms reporting	Average per farm	Average per farm reporting	Acreage irrigated	Acreage fertilized	Yield per acre
	Percent	Acre	Acre	Percent	Percent	
Total number farms - 8,288:						
Total acres - 5.8 million :						
Total land (acres) .....:	100	702	702	40	34	
Cropland .....:	93	309	332	73		
Cotton .....:	27	97	361	100	99	2.0 bls.
Wheat .....:	4	15	400	85	84	57 bu.
Barley .....:	7	37	505	90	90	66 bu.
Sorghum .....:	3	3	127	100	78	1/ 58 bu.
Hay .....:	21	33	155	98	34	5.9 tons
Vegetables .....:	5	14	284	100	97	
Orchards .....:	61	56	93	94	74	
:						
Irrigated land .....:	90	280	313	100		
Furrows or ditches .....:	72	153	212			
Sprinkler systems .....:	11	50	477			
Irrigated cropland .....:	81	225	278	100		
Land fertilized .....:	73	239	326		100	
Row crop insecticides ....:	52	176	336			
Crop herbicides .....:	29	141	481			
Defoliants .....:	15	75	510			
Ownership: :						
Full owners .....:	68	155	227			
Part owners .....:	23	397	1,694			
Tenants .....:	10	151	1,442			
Size: :						
100-499 acres .....:	22					
500-1,999 acres .....:	9					
2,000 acres and over ...:	5					
:						
Operator age 65 and over :	16					
Operators working off-farm:						
200 days and over .....:	24					
:		Number				
Wheel tractors .....:	86	2.6	3.1			
1970 or newer .....:		0.8	0.9			
Crawler tractors .....:	15	0.3	2.2			
Acre ft. irrigation :						
water applied per acre :			2.9			
:						

1/ Harvested for grain

Source: Bureau of the Census, U.S. Dept. of Commerce, 1974 Census of Agriculture

Appendix Table 8. Selected characteristics of farms with sales of at least $2,500, San Joaquin 2, 1974

Item	Farms reporting	Average per farm	Average per farm reporting	Acreage irrigated	Acreage fertilized	Yield per acre
	Percent	Acre	Acre	Percent	Percent	
Total number farms - 7,794:						
Total acres - 3.0 million :						
Total land (acres) .....:	100	390	390	40	31	
Cropland .....:	93	175	188	81		
Cotton .....:	18	32	181	100	98	1.7 bls.
Wheat .....:	4	7	187	70	68	46 bu.
Barley .....:	5	9	172	66	64	54 bu.
Sorghum .....:	4	3	85	100	72	1/72 bu.
Hay .....:	24	31	130	94	43	5.0 tons
Vegetables .....:	3	3	95	100	83	
Orchards .....:	62	49	79	95	78	
Irrigated land .....:	89	154	174	100		
Furrows or ditches .....:	58	89	153			
Sprinkler systems .....:	17	15	85			
Irrigated cropland .....:	85	142	166	100		
Land fertilized .....:	73	120	165		100	
Row crop insecticides ....:	42	72	169			
Crop herbicides .....:	28	53	191			
Defoliants .....:	9	20	227			
Ownership:						
Full owners .....:	71	124	175			
Part owners .....:	21	212	1,022			
Tenants .....:	8	56	641			
Size:						
100-499 acres .....:	23					
500-1,999 acres .....:	9					
2,000 acres and over ...:	3					
Operator age 65 and over :	18					
Operators working off-farm:						
200 days and over .....:	26					
			Number			
Wheel tractors .....:	79		2.1	2.7		
1970 or newer .....:			0.6	0.7		
Crawler tractors .....:	0.2		0.3	1.5		
Acre ft. irrigation water applied per acre :				1.6		

1/ Harvested for grain

Source: Bureau of the Census, U.S. Dept. of Commerce, 1974 Census of Agriculture

Appendix Table 9. Selected characteristics of farms with sales of at least $2,500, San Joaquin 1, 1969

Item	Farms reporting	Average per farm	Average per farm reporting	Acreage irrigated	Acreage fertilized	Yield per acre
	Percent	Acre	Acre	Percent	Percent	
Total number farms - 8,382:						
Total acres - 6.6 million :						
Total land (acres) .....:	100	793	793	31	26	
Cropland .....:	93	303	327	79		
Cotton .....:	29	51	174	100	99	2.0 bls.
Wheat .....:	4	9	254	71	68	41 bu.
Barley .....:	11	41	378	92	88	54 bu.
Sorghum .....:	6	8	126	99	91	1/55 bu.
Hay .....:	21	32	152	98	30	5.9 tons
Vegetables .....:	5	10	187	100	95	
Orchards .....:	62	41	66	97	90	
:						
Irrigated land .....:	87	245	281	100		
Furrows or ditches .....:						
Sprinkler systems .....:						
Irrigated cropland .....:	87	239	276	100		
:						
Land fertilized .....:	82	205	250		100	
Row crop insecticides ....:	65	126	193			
Crop herbicides .....:	30	77	257			
Defoliants .....:	21	50	237			
Ownership: :						
Full owners .....:	63	98	157			
Part owners .....:	27	568	2,124			
Tenants .....:	11	126	1,180			
Size: :						
100-499 acres .....:	23					
500-1,999 acres .....:	9					
2,000 acres and over ...:	5					
:						
Operator age 65 and over :	14					
Operators working off-farm:						
200 days and over .....:	27					
:		Number				
Wheel tractors .....:	88	2.3	2.6			
1965 or newer .....:		0.6	0.7			
Crawler tractors .....:	21	0.4	2.1			
Acre ft. irrigation :						
water applies per acre :			N.A.			
:						

1/ Harvested for grain

Source: Bureau of the Census, U.S. Dept. of Commerce, 1974 Census of Agriculture

Appendix Table 10. Selected characteristics of farms with sales of at least $2,500, San Joaquin 2, 1969

Item	Farms reporting	Average per farm	Average per farm reporting	Acreage irrigated	Acreage fertilized	Yield per acre
	Percent	Acre	Acre	Percent	Percent	
Total number farms - 8,150						
Total acres - 3.0 million						
Total land (acres)	100	366	366	37	30	
Cropland	92	171	185	77		
Cotton	20	21	105	100	98	1.6 bls.
Wheat	3	5	173	51	50	36 bu.
Barley	8	13	167	65	60	42 bu.
Sorghum	6	6	110	100	91	1/ 60 bu.
Hay	23	25	109	94	36	5.4 tons
Vegetables	4	3	83	100	89	
Orchards	61	40	65	97	90	
Irrigated land	86	135	157	100		
Furrows or ditches						
Sprinkler systems						
Irrigated cropland	85	132	154	100		
Land fertilized	77	111	145		100	
Row crop insecticides	53	56	106			
Crop herbicides	29	34	119			
Defoliants	13	15	117			
Ownership:						
Full owners	68	108	160			
Part owners	23	215	923			
Tenants	9	43	473			
Size:						
100-499 acres	25					
500-1,999 acres	8					
2,000 acres and over	3					
Operator age 65 and over	14					
Operators working off-farm						
200 days and over	29					
		Number				
Wheel tractors	80	1.9	2.4			
1965 or newer		0.5	0.6			
Crawler tractors	26	0.4	1.5			
Acre ft. irrigation water applied per acre			N.A.			

1/ Harvested for grain

Source: Bureau of the Census, U.S. Dept. of Commerce, 1974 Census of Agriculture